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Challenges Faced by Consumers of Ghana Water Company and the Way Forward: The Case of Tamale Metropolis, Ghana

Mohammed Tanko[1*], Fuseini Awal[1] and Abukari Iddrisu[1]

[1]Department of Agricultural and Resource Economics, Faculty of Agribusiness and Communication Sciences, University for Development Studies, Tamale, Ghana.

Authors' contributions

This research is a collaborative work coordinated by the corresponding authors. Author MT designed the study and wrote the protocol. The background and the literature were written by authors FA and AI. Authors MT and FA wrote the methodology and did the analysis. All authors read and approved the final manuscript.

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ABSTRACT

The research assesses the challenges consumers of Ghana Water Company faced and the factors that determine consumers' willingness to pay for improved water supply either from the company or private service provider. The study employed a multistage sampling technique in selecting respondents. Tamale Metropolis was purposively selected and was divided in to four electoral areas in which fifty respondents were selected from each area using systematic sampling through the selection of every fifth house in each area. Kendall`s W was employed to rank the identified challenges consumers faced for being clients of Ghana Water Company Limited (GWCL) while logistic regression was used to analysed the determinants of consumers` willingness to pay. The results indicate that, consumers faced some challenges in dealing with the public utility company, though there is less agreement among the respondents. In ranking challenges faced by consumers, it was evidence that, high water charges were ranked as the most prioritized constrain with a mean rank of 2.61 and poor relationship between customers and the public water company

**Corresponding author: E-mail: tanko201085@yahoo.com;*

was ranked last with mean rank of 4.72. Assessing consumers` willingness to pay for improved water supply indicates that about 75% of the respondents were willing to pay (WTP) twice the previous amount they used to pay and the mean willingness to pay was ¢67.30 (US$17.71) for monthly consumption. Also, it was observed that, Number of days' water flow from pipes and the income of respondents were significantly negatively related with willingness to pay whilst expenditure consumers made on alternative water sources was positively related with consumers` willingness to pay for improved water service. It was observed that, with time when all the variables in consideration remain the same, the willing to pay for an improved water supply is likely to rise as the constant term has a positive sign and is significant at one percent level.

Keywords: Tamale; Northern Region; Ghana; logit model; willingness to pay; water; contingent valuation.

1. INTRODUCTION

Water undoubtedly is an indispensable resource which supply improvement cannot be underestimated. Due to the serious risk people are exposed to in terms of water related diseases, cognisance must be taken during the process of water supply and delivery. Whiles safe, sufficient and sustainable water provision remains the core goal of every country, many people lack access to it. The World Bank in a report did indicate that about 1.1 billion people globally lack access to safe and potable drinking water. The situation is even anticipated to worsen taking into consideration the recent surge in the world's population [1].

Ghana has a chunk of its water supply provided by the state owned Ghana Water Company Limited (GWCL). In spite of the numerous efforts targeted to increase efficiency, the state company is struck with various degrees of inefficiencies. These have triggered the calls for an increased investment in the sector and countless upward tariff adjustment dovetailing each other. The Public Utility Regulatory Commission (PURC) over the period have incessantly increased tariffs on water with the latest being 15 percent as at July, 2015. That notwithstanding, the commission further frightens users with an over 100 percent increment for the last quarter of 2015, which is being heavily contested by the Trade Union Congress (TUC) of Ghana. These are all manifest indication of efforts geared towards increased efficiency and improving the water supply systems in the country [2].

The chief manager in charge of geographic information systems at the GWCL, Richard Appiah Otoo at a 50th anniversary symposium of the company in Accra stated 'we need about USD 2 billion to make sure we achieve 100 percent coverage of all urban dwellers for the next 10 years' [3]. This indicates the extra amount of investment required in order to curtail the irregular and unreliable supply of water to urban dwellers. Most clients of GWCL are either working at the public sectors or are privately engaged in their own enterprises. Invariably as an alternative, they also used water from water vendors whose primary motive is driven by profit maximisation. The clients could have afforded the increased in tariff by the public water company provider however, the question many consumers asked themselves is, would there be expectantly a better and a more reliably safe improvement in water supply from the utility provider?

Therefore, the need to research into the challenges consumers faced with the public water provider and ascertain the willingness of customers to pay for an alternative water supply in Tamale is imperative, due to the crave for a sustainable and consistent supply of the resource. The research therefore hinges on customers' constraints and willingness to accept and pay for an alternative water source. This is achieved using the Kendall`s Coefficient of Concordance (KCC) and Contingency Valuation Method (CVM) to value the stated market and the appropriate responses collected, collated and analysed for informed policy.

2. LITERATURE REVIEW

2.1 Kendall`s Coefficient

Kendall`s coefficient of concordance is a non-parametric statistic Proposed by Maurice G. Kendall and Bernard Babington Smith and later adapted by many researchers in examining the agreement of level of respondents. It is an improvement of the Friedman test and ranges from 0 to 1. According to [4], there is a close

relationship between Milton Friedman's two-way approach of variance without replication by ranks and Kendall's coefficient of concordance. They both address hypotheses concerning the same analysis and use the same chi-square statistic in their decision making. But they differ in the formulation of their respective null hypothesis. Two events can be compared using standard Pearson correlation coefficient which assumed normality in the distribution of values, however, Kendall's W does not make any assumption with respect to the distribution of the probability distribution of a variable. It also, cater the challenge of varied values of different outcome.

[5] adapt Kendall W to analyse associationship that exist between species, using ordinary ranking through expertise knowledge in prioritising products, service, development project and programmes with an intended aim of putting different priority in to a single conscious or agreed ranking proved to be inefficient by [5] as the targets do depend on the degree of ranking. With random ranking with wider degree of levels in goats, the final or whole agreement has little sense relative to closer degree of levels.

Kendall`s W significant test level mainly depends solely on the order or arrangement of the pairs [6]. In computing Kendall`s W, it is assumed that one of the orders of ranks serves as a reference point.

2.2 Willingness to Accept and Pay

The research dwelled on willingness to pay (WTP) by employing contingent valuation method (CVM) to assess consumers` willingness to pay for improved water supply. There are two fundamental approaches that are used to feel good about the act of giving for social service. The indirect approach involves observations- According to [7], consumers are willing to accept for natural resources than they are willing to pay for the same natural resources due to psychological differences. The psychological value of something a person owns is greater than something that is not own. In other words, a person would need extra compensation to be as well off without it than the person would be willing to pay to get that same good and as such people would be less willing to give it up (WTA > WTP). In the presence of close substitutes, WTP and WTA should not be that divergent, but the gap between the two measures should increase as the degree of substitution minimises [8]. [9] find that for "ordinary goods" the discrepancy between WTA and WTP is lower than the ratio of WTA/WTP for public and non-market `goods.

The willingness to pay for resources by a consumer was determined by the expenditure function, because utility is un-measureable, [10] have criticised that; the method is cumbersome in empirical studies. Hence, an indirect utility function which is derived from consumer behaviour theory has been used to derive WTP as used by [11] for safe drinking water in Vietnam. A modified utility function for inconsistent and unreliable water supply for household in Tamale is stated as follows:

$$L = L(P, Q_0^W, Y_0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: L is the utility a consumer derived for using water, P is the exogenous price vector, Q_0^W is the unimproved quantity of water households received from the GWCL in litres and Y is the income of the consumer in Ghanaian cedi.

If a consumer is willing to pay Gh¢Z for improvement in the supply of water, either from the public sector or any private organisation by acquiring X litres of water, The water utility function becomes:

$$L^* = L^*(P, Q_0^W + X, Y_0 - Z) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

At equilibrium, the utility function of unreliable and inconsistent water supply equals the utility function of improved water supply (i.e. equation (1) = equation (2) because of the balanced of additional water and loss of income by the consumer. The equilibrium condition is presented as:

$$L = L(P, Q_0^W, Y_0) \approx L^* = L^*(P, Q_0^W + X, Y_0 - Z) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

It is assumed that the improvement in the quality and quantity of water supply and the change in income as a result of the demand for quality service are very insignificant. This implies, the first order approximation of the improved water supply utility function (2) is given as:

$$L = L(P, Q_0^W, Y_0) \approx L^* = L^*(P, Q_0^W + X, Y_0 - Z) - \frac{\partial L(P, Q_O^W, Y_0) Z}{\partial Y_O} + \frac{\partial L(P, Q_O^W, Y_0) X}{\partial Q_0^W} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The summation of equation (3) and (4) yields

$$-\frac{\partial L(P,Q_O^W,Y_0)Z}{\partial Y_O}+\frac{\partial L(P,Q_O^W,Y_0)X}{\partial Q_0^W}=0.....(5)$$

When Z is made a subject, it results WTP bids

$$WTP = Z = \frac{\partial L(P,Q_O^W,Y_0)\Big/\partial Q_0^W}{\partial L(P,Q_O^W,Y_0)\Big/\partial Y_O} X ..... (6)$$

Where $\partial L(P,Q_O^W,Y_0)\Big/\partial Q_0^W$ is an additional satisfaction derived for a litre of water (marginal utility of water) as a result of an improvement in the water supply. If a household is not willing to pay for improvement in water supply, then, the household has no marginal utility for improvement in water supply. Meaning, the left hand side of equation (6) is zero. The unwillingness on the part of the consumer to pay but will be willing to accept (WTA) due to psychological value as asserted by [7] and also, because such people are within the very poor poverty region and will not use the increase in their income to settle for reliable water supply but rather will commit those funds into buying basic necessities of life such as food, water and clothing [12].

Taking the natural log of equation (6) gives

$$\ln WTP = \ln\left[\frac{\partial L(P,Q_O^W,Y_0)}{\partial Q_0^W}\right]-\ln\left[\frac{\partial L(P,Q_O^W,Y_0)}{\partial Y_0}\right] + \ln X ....(7)$$

The equation (7) implies that, marginal utility for improvement in water supply, marginal utility for money and quality of service provided are factors that determine the willingness to pay capacity of households.

Valuing economic resources like water could take a revealed preference method or stated preference method. This research employed the most direct stated preference approach of Contingent Valuation Method (CVM) which provides a means of deriving values that cannot be obtained in more traditional ways. The simplest version of the contingent approach merely asks respondents what value they would place on an environmental change (such as improvement in water supply) or on preserving the resource in its current state.

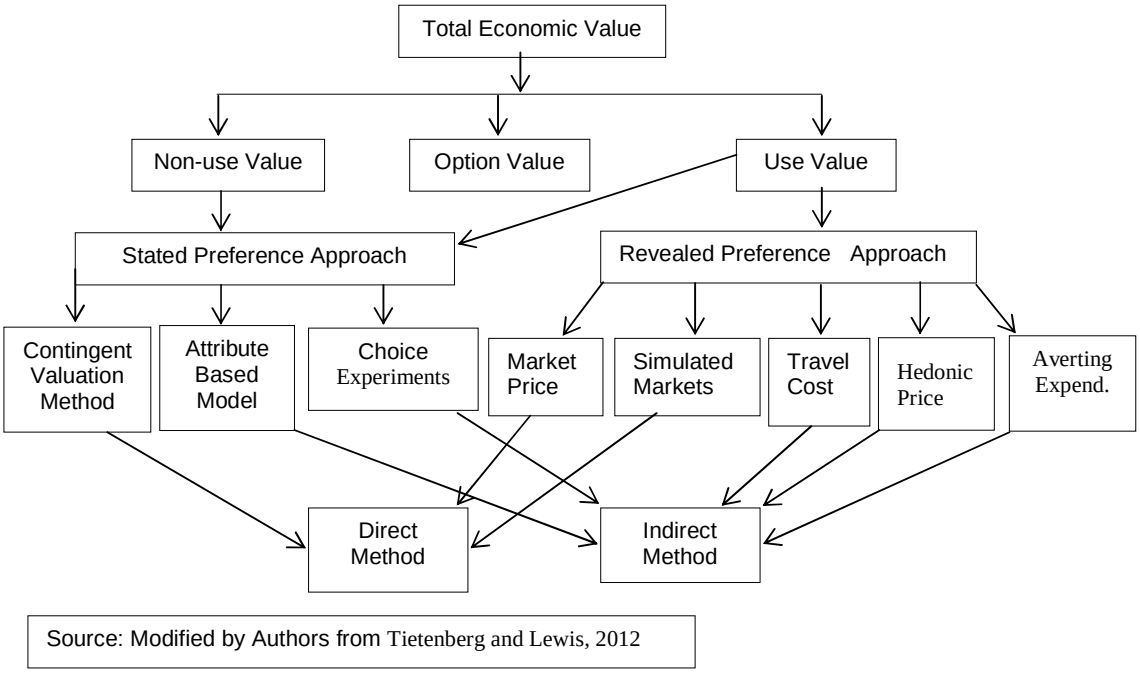

Fig. 1. Economic methods for measuring resource values

Alternative approach requires a "yes" or "no" question such as whether or not the respondent would pay $*X* or additional 50% of the previous cost to prevent the change or preserve resources [13].

The Respondents to contingent valuation surveys tend to report much greater values when questioned about their willingness to accept compensation for a specified loss of some good or service than when questioned about their willingness to pay for a specified increase of that same good or service [8,12,13]. This research does not allow respondents to state the amount they were willing to pay. However, households were asked whether or not they were willing to pay additional hundred percent of their previous payment (double) to enjoy improvement in water supply.

According to [14] household income had a negative and statistically significant impact on WTP for quantity. Households with higher income are less willing to pay for improved water quantity: this is not in line with earlier findings by [12] and [15] who reported a direct and worth essential impact between WTP for quantity and household income.

They further stated in their findings that, the more a household consumes water, the less that household is WTP to have improved water availability in terms of quantity. Households that have a regular supply of tap water were less willing to pay for betterment of the quantity. These households are more likely to choose to maintain the status quo.

3. METHODOLOGY

3.1 Study Area

The research was carried out at the regional capital of Northern region, Tamale, which is the largest region in Ghana in terms of land mass among the ten regions. Tamale shares boundary with five administrative districts namely Savelugu- Nanton district, Yendi Municipality, East Gonja district and Tolon-Kumbungu district to the North, East, South and West respectively. It is the centre of administration in the region. Based on electoral colleges, Tamale has four electoral constituencies which include Tamale central constituency (TCC), Tamale south constituency (TSC), Tamale north constituency (TSC) and Sagnarigu constituency (SC). The four constituencies within the Tamale metropolis source their water supply from the Ghana Water Company Limited (GWCL) with its plant located at Dalun. Irrespective of the population as well as industrial and residential development of the metropolis, the water supply has improved by insignificant level. The water plant cannot produce up to the consumption level of the consumers leading to a deficiency in water supply. All water supply agencies are connected to the Dalun plant which includes Gumo sub-station. Village water is another source that provides borehole and well to supplement the pipe borne water. However, not all residents in the metropolis are benefiting the project of village water, hence, most people are still facing inconsistent and unreliable water supply.

3.2 Data Collection and Sampling Technique

The study employed primary data from the study area. The data was collected using structured questionnaires. A multistage sampling technique was employed. The first stage involved the use of purposive sampling techniques in selecting the study area, selection of the four constituencies and those who are clients to the Ghana water company limited based on their connection to the national water pipe line. Tamale was selected purposively because of the heterogeneity nature of the population and the connection of the people to the public water supply company. Systematic sampling technique was used to select the final respondents from the four constituencies in which every 5^{th} house in all the four areas was selected and a household in each house was interviewed, even, if the house has more than one water metre or household, only one household was interviewed on face-to-face interaction. The households who were interviewed numbered 200. Fifty (50) households were selected from each of the four constituencies in Tamale metropolis. Data was collected on Households' socio-economic characteristics, organised and analysed to determine factors that influence consumers` WTP for an improved water supply after setting a hypothetical market. The hypothetical market was formed based on the pipe borne water from Ghana Water Company Limited (GWCL) consumption level of a household as the consumptions levels of different households varied in the bills. It was assumed that, if a reliable and improved water supply is made available for water to flow at all time – seven days a week, will the household be willing to pay based on their consumption.

3.3 Empirical Model

Descriptive statistics such as frequency distribution tables, mean and standard deviation were used to analyse the socioeconomic characteristics of the respondents. The challenges clients faced in the use of public water from the Ghana water company Limited was ranked using Kendall's coefficient of concordance and the mean willingness to pay for improved water supply by households was determined by the logit regression model.

3.3.1 Kendall's coefficient of concordance

The Kendall's coefficient of concordance was used to rank some of the challenges that consumers of GWCL experienced in their affair with the company. The Kendall's *W* is a measure of the degree of agreements level among several respondents who are suffering a given set of *n* objectives (challenges) [16]. *W* denotes an index that measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of the ranks. The idea behind this index is to find the sum of the ranks for each challenges been ranked. If the ranking is in perfect agreement, the variability among this sum will be maximum [17]. According to [16], the Kendall's coefficient of concordance *(W)* is given by the relation

$$w = \frac{12S}{P^2(n^3 - n)} - P^T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where: *W* denotes the Kendall's coefficient of concordance*; P* denotes number of respondents ranking the challenges, *n* denotes the number of quality perceptions' denotes correction factor for tied ranks, *S* denotes sum of squares statistics over the row sum of ranks (R_i).

The sum of square statistics (*S)* is given as:

$$S = \sum_{i-1}^{n} (R_i - R)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where R_i is row sums of rank and *R* is the mean of R_i

The correction factor for tied ranks (T) is also given as:

$$T = \sum_{k=1}^{m} (t_k^3 - t_k) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Where t^3 is the number of ranks in each of *m* group of ties

The test of significance of the Kendall's coefficient of concordance will be done using the chi-square statistics which is computed using the formulae:

$$X^2 = P(n-1)W \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11);$$

Where *n* is the number of constraints, *P* is the number of respondents and *W* is Kendall's coefficient of concordance.

The null hypothesis for the Kendall's is that, there is no agreement among respondents on the challenges faced while the alternative stood that, there is at least some agreement among respondents. If the calculated chi-square is greater than the critical chi-square, then the null hypothesis is rejected in favour of the alternative hypothesis that there is agreement among the ranking of the constraints by the respondents.

3.3.2 Logit regression model

The logit regression model was employed to obtain the willingness to pay of households for an improved water supply in Tamale metropolis. The logit model allows for a relatively straight forward computation of the comparative mean of the dependent variable or elasticity given the estimated coefficient of the regressors. Thus, whether a consumer was willing to pay for improved water supply or not is explained by observable individual socio-economic characteristics or factors within the logit framework. In this research, the outcomes of the response matter (whether consumer was willingness to pay or not). Though, the major interest is the likelihood or probability of the outcome.

If Y is a random variable (dichotomous), it can then be assumed that Y takes the value of 0 or 1, where 0 denotes the non-occurrence of the event in question and 1 denotes the occurrence. $X1 \ldots\ldots Xp$ are the characteristics to be related to occurrence of this outcome, and the logistic model specifies that the conditional probability of event (i.e., that *Y=1*) gives the values of $X1 \ldots\ldots Xp$ as follows:

The logit regression model that was used to obtain the willingness to pay of households for an improved water supply is stated below.

$$P_i = E(Y = 1/X_i) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1)}} \quad \ldots\ldots(12)$$

Where: P_i is a probability that $Yi = 1$, X_i is a set of independent variables, Y is dependent variable, $ß_0$is the intercept which is constant and $ß_1$is the coefficient of the price that the households are willing to pay for improved water supply. The coefficient estimates obtained subsequently used to calculate the mean willingness to pay of the households. The mean willingness to pay for improved water supply by households was calculated using the formula derived by [12] and given as:

$$MeanWTP = \frac{1 * \ln(1+\exp^{\beta_0})}{/\beta_1/} \quad \ldots\ldots\ldots(13)$$

Where $ß_0$ and $ß_1$ are absolute coefficient estimates from the logistic regression and the *Mean WTP* is the mean for the improved water supply by households.

Identification of significant factors that influence households' willingness to pay for improved water supply in Tamale metropolis called for the regressing of households' response to the willingness to pay question against the prices of WTP and other socio-economic characteristics of the household. The regression for logit model is specified as follows:

$$Y = \frac{1}{1+\exp^{z}} \quad \ldots\ldots\ldots(14)$$

Where Y = responses of household WTP which is 1 for Yes and 0 otherwise

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_9 X_9 + \varepsilon \quad \ldots\ldots\ldots(15)$$

X_1= Age (years)
X_2= Educational level (number of years spent in the school)
X_3= Household size
X_4= Household monthly expenditure on alternative water source
X_5= Household monthly income
X_6= Connection charges (N)
X_7 = Sex (Female=0, Male=1)
X_8 = Residential status (Tenant = 0, owned a house = 1)
X_9 = Number of days pipes flow

The Cox & Snell R Square, Nagelkerke R Square and chi-square were used to measure the goodness of fit of the model and the significance of the model used.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The results from the Table 3 indicate that, 67 percent of the respondents are male whiles 66 percent are female. To know the maturity level of the respondent, age analysis was done which shows that 46 percent was aged 30 years and below, 45 percent was aged between 30 to 50 years and 9 percent were 51 years and above. Furthermore, 89 percent of the sample has a household size of ten and below, 10.5 percent has between eleven and twenty whiles 0.5 percent has more than 21 household members. It is important to know that, most of the interviewees were house owners representing 58.5 and the remaining 41.5 percent were tenants.

With respect to the incomes of respondents, 64 percent of the respondents earned income of ¢1000 or below, 9.5 percent was found to earned income between ¢1000-2000 and 0.5 percent earned incomes above ¢2000. Non income earners due to lack of employment were 26 percent. Out of the income earned, respondents spent some on water monthly and the research shows that, 58 percent of them spent ¢30 or less on water, 25 percent spent between ¢31-50 on water monthly whiles 16.5 percent spent ¢51 or more monthly. On average, clients used 2.1% of their monthly income to settle for water bill monthly.

The results further indicate that, the fees paid by clients at first connection to the (GWCL) source. About 13 clients representing 6.5 percent paid ¢100 or less to get their houses connected. Whiles 11 percent being 22 clients paid between ¢101-200. The remaining 41.5 percent representing 83 clients paid ¢201 or more in order to get their houses connected. It must also be noted that, 82 respondents could not respond on the connection fee due to fact that, they are tenants and have no proper information on that subject.

4.2 Kendall's Co-efficient of Concordance

The results of the Kendall`s Co-efficient of Concordance are presented in Table 1. From the

Table 1, it is evidence that, high water tariffs imposed by the Ghana Water Company Limited (GWCL) was considered and ranked as the most prioritised challenge with a mean rank of 2.61. The next most challenging factor by consumers` of GWCL service was intermittent water supply bearing a mean rank of 3.48. Inadequate information to consumers of pipe water in the case of emergency outage, high connection and reconnection fees, improper treatment of water leading to diseases and the low nature of the amount that service provider requires a customer to owed for disconnection to take place were ranked as the third, fourth, fifth and sixth challenges with mean ranks of 3.86, 4.22, 4.43 and 4.69 respectively. Poor relationship between the public water provider (GWCL) and the clients in terms of sharing bills, reconnection and customer care attendance among other was considered as the least challenge. The Kendall`s co-efficient (0.123) shows less agreement among respondents in the ranking of the challenging. However, it is significant at 99 percent confident level as the significant values is 0.000.

4.3 Alternative Sources of Water

Notwithstanding GWCL as the main provider of water, there are other alternative sources of water respondents seek in times of short supply from the main source. This is strengthened by the fact that, some clients do not have storage facilities to house enough water, hence they resort to immediate alternatives since average days water flow is 16 days monthly. These alternative sources are boreholes, wells, river/dams, sachet water, and water vendors. Results from Table 3 indicate that, 9.5 percent of respondents use borehole as their immediate alternative. It further shows that, 15.4 percent use wells as against 16.4 percent users of river as their immediate alternative. Whiles 4.5 percent use sachet water, 26.4 percent use water vendors as their immediate alternative source. It is also noted that, 27.4 percent do not use any of the alternatives mentioned due to the present of storage facilities or they are suffering the consequences of the water shortage.

4.4 Logistic Regression

On the subject of whether customers are willing to pay or otherwise for improve water supply, the results indicate that, whiles 150 respondents representing 75 percent was willing to pay for improve water supply, 50 respondents representing 25 percent was unwilling to pay. The mean willingness to pay for a monthly use of water was ¢67.30 (US$17.71). The Table 2 indicates the results for logistic regression that was conducted to ascertain the factors that determine the willingness of consumer of public water in Tamale Metropolis to pay for improved water supply. From, critical analysis, it shows that, the age of consumers, Household size, sex of respondents, residential status, respondent level of education and connection charges paid to connect consumers to improved water source are statistically insignificant in influencing consumers` willingness to pay (WTP) for an improved water services. However, an amount of money that a consumer earned at the end of a month, expenditure made by respondents in sourcing alternative water such as borehole, well, water vendors among others and number of days water flow from pipes at the study area are statistically influential factors that determine consumers' willingness to pay for an improved water supply as their significant values are less than 1%.

Respondents' age, level of education, monthly income and monthly expenditure on alternative source of water has positive relationship with consumers` willingness to pay for improved water. This means that, an increase in respondents' age, level of education, monthly income and monthly expenditure on alternative source of water is likely to induce the desire of consumers' willingness to pay for improved service of water positively. The co-efficient for monthly income and monthly expenditure on alternative sources are positively statistically significant at 99% confident level. This implies an increase in the proportion of consumers' monthly income and the monies that consumers spent in accessing alternative water will increase the tendencies of consumers` willingness to pay for sourcing improved water. The positive income behaviour is in conformity with the research results of [18], [19] and [20]. The reason for the positivity can be attributed to an increase in purchasing power of respondents when there is an increase in income. This will enable consumers have the power to either purchase state water or alternative sources of water such as sachet water and vendor water, hence, increasing the desire of consumers` willingness to pay for improved water service. Also, when consumers' expenditure on alternative water increases, it reduces their real income which is likely to increase their willingness to pay for improved water supply. The sex of respondents, residential status, number of day's water flow

Table 1. Rank of water supply challenges

Challenges	Mean rank	Rank
High water charges/tariff	2.61	1st
Intermittent water supply	3.48	2nd
Inadequate information on emergency outage	3.86	3rd
High connection and reconnection fees/charges	4.22	4th
Improper treatment of water	4.43	5th
Minimum amount due for disconnection is low	4.69	6th
Poor relation between GWCL and users	4.72	7th

N= 200, Kendall`s W[a]= 0.123, Chi-Square = 147.465, Sig. = 0.000
Source: Authors` computation

Table 2. Determinants of willingness to pay for improved water supply

Variable	Co-efficient	Std. error	P-value
Gender	-0.021	0.423	0.960
Age	0.226	0.188	0.230
Household size	-0.019	0.334	0.954
Residential status	-0.312	0.503	0.534
Education level	0.116	0.137	0.401
Monthly income	0.013	0.005	0.007***
Monthly expenditure on alternative	0.384	0.144	0.008***
Days of flow of water	-0.641	0.146	0.000***
Connection charges	-0.006	0.005	0.211
Constant	2.292	0.989	0.020**
Number of Observation 200			
Chi-square 53.304			
Significant levels 0.000			
Degrees of freedom 9			
-2 Log likelihood 171.053			
Cox & Snell R Square 0.235			
Nagelkerke R Square 0.348			

**** and ** denote 1% and 5% respectively*
Source: Authors` computation

from GWCL, household size and connection charges are negatively related to consumers` willingness to pay for improved water supply. The co-efficient for number of days respondents could receive or experience the flow of water is statistically significant at $P < 0.01$. This means that, an increase in the number of days that GWCL will open pipes for consumers is likely to reduce the willingness of respondents for the payment of improved water service.

The intercept parameter is positive and is statistically significant at 5 percent. This implies, when all the variables are constant or remain the same, thus, no fluctuation in the age of respondents, respondents' household size, level of education, monthly income, monthly expenditures on alternative water service, days water flow from pipes and connection charges as well as irrespective of the gender and residential status of the respondents, there is the tendency that, respondents will increase their willingness to pay for the services of improved water supply. The positive behaviour of the constant by implication indicates the significant deterioration of the public sector water provision service (GWCL) in supply with time as consumers` willingness to pay is likely to increase. Therefore, there is the need for appropriate government policies to improve water supply at the public sector.

5. CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion

It was undeniable fact that water supply in Tamale Metropolis was inconsistent and unreliable. This is a national problem and the situation in Tamale was not different. The

rendering of unimproved water service to clients by the public water provider can be attributed to the high growth of population and the used of archaic equipment or water plan by the utility company. Many entrepreneurs have taken advantage of the water challenges in the study area by vending water which seems to be low quality relative to water state provides except the sachet water which is quality but comparatively expensive. High water charge was ranked as the highest challenge respondents' face. Follow by intermittent supply. This could be due to the fact that; the high tariffs are not in tendon with the characteristics of the water flow. The research indicates that, about 75% of consumers of water from GWCL were willing to pay about 100% increment in their previous water bills to benefit for an improve water supply either from the state or private suppliers. The mean willingness to pay was ¢67.30 (US$17.71) for a monthly use of water. Their willingness to pay for improved water was derived significantly by the number of day water flow from their pipes, the value of money spent on alternative water and the monthly income of the consumer. The critical variables to consumers of water were reliability, consistent and significant flow of water.

5.2 Policy Recommendation

It is recommended that, policy makers and private water suppliers should consider supply of improved water as a critical factor as majority of the consumers were willing to pay for such valuable resource.

To cater for the growing population and the used of old water plans, the government would have to increase the budgetary allocation to the water sector in order that inefficiencies would be minimised. The analyses further inform those in policy that, a parallel institution in the provision of water is feasible and lucrative. Therefore, private investors can take the opportunity to invest in this area taking count of the legal and the regulatory environment.

State Water Company could achieve the tariff increase of about 100% easily when there is an increase in the prices of alternative water supply and vice versa. It was discovered that, when consumers` expenditure on alternative water rise, they would be more willing to pay for improve water service. Therefore, government can impose more tariffs such as excise duties on domestically produce water to increase their price to earn more revenue and improve consumers' willingness to pay.

The research shows that, clients of GWCL are willing to pay for improved alternative water supply if the situation of the state service still exist or worsen; however, an improvement in the service would lead to less willing to pay for an alternative water service. Also, is an indication from the findings that, the target market for private supplier should be the rich and not the poor, that is, an increase in the monthly income of the consumer is likely to increase the purchasing power widening his choice of water.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Table 3. Summary statistics of respondents

Variables	Frequency	Percent
	Sex of respondents	
Male	134	67
Female	66	33
Total	200	100
	Age (Years)	
30 and below	92	46
31-50	90	45
51 and below	27	9
Total	200	100
	Household size	
10 and below	178	89
11-20	21	10.5
21 and above	1	0.5
Total	200	100
	Relation to house	
Owner	117	58.5
Tenant	83	41.5
Total	200	100.0
	Total years spent on education	
10 and below	85	42.5
11-20	114	57
21 and above	1	0.5
Total	200	100
	Employment status	
Employed	136	68.0
Unemployed	64	32.0
Total	200	100.0
	Income (¢)	
1000 and below	128	64.0
1001-2000	19	9.5
2001 and above	1	0.5
Non income earners	52	26
Total	200	100
	Monthly expenditure on water(¢)	
30 and below	116	58.0
31-50	51	25
51 and below	33	16.5
Total	200	100
	Connection charge(¢)	
100 and below	13	6.5
101-200	22	11
201 and above	83	41.5
Not known	82	41.0
Total	200	100
	Type of alternative source	
Borehole	19	9.5
Well	31	15.5
River	33	16.5
Sachet	9	4.5
Water vendor	53	26.5
Don’t have	55	27.5
Total	200	100.0

	Monthly expenditure on alternative source(¢)	
10 and below	135	67.5
11-20	27	13.5
21-30	10	5
31-40	41	2.0
41 and above	24	12.0
Total	200	100
	Days of water flow(number of days)	
10 and below	41	20.5
11-15	59	29.5
16-20	33	16.5
21-25	28	14.0
26 and above	39	19.5
Total	200	100.0

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